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ABSTRACT

Reported is a study to determine the attitudes of Israeli high school biology teachers to the Israeli adaptation of the Biological Sciences Curriculum Study (BSCS) curriculum. Blankenship's Attitude Inventory, designed to determine teachers' reactions to BSCS materials, was translated into Hebrew. Copies were mailed to 200 high schools in Israel. Teachers were also asked to identify their sex, the type of school (agricultural, kibbutz, comprehensive, city academic), and curriculum used (BSCS, traditional, mixture of both). One hundred eleven complete inventories were returned. Data were analyzed using t-tests and the Chi-square method. Among the major findings were: (1) those teachers using the BSCS materials exhibited attitudes more favorable to BSCS philosophy and rationale than did teachers using traditional materials, with increased experience in using BSCS resulting in increasingly positive attitudes; (2) the BSCS program was most highly regarded by teachers in rural-kibbutz schools and least highly regarded by teachers in city academic schools. (Author/PEB)

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The Attitudes of High School Biology Teachers to the BSCS Program in Israel

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In 1965 the Israeli adaptation of the BSCS Yellow Version (1) was introduced to 12 classrooms. Since then the program has been increasingly adopted, on voluntary basis, by more teachers and more schools. In addition to the Yellow Version, two other BSCS courses were adapted and translated into Hebrew, namely Patterns and Processes (2) and the BSCS second course: Interaction of Experiments and Ideas (3). In 1973 more than 60% of the high school biology students were using BSCS materials. Since its beginning the Israel BSCS Adaptation Project (IBAP), based on the recognition that "merely providing new curricular materials, however good they may be, will not necessarily result in improved biology teaching (since) the teacher remains the key"(4), has put special efforts into inservice training. More than 500 (2/3 of the high school biology teachers in the country) participated in two to three weeks BSCS summer institutes and many of these teachers have continuously participated in other inservice training activities which have been offered weekly during the school year as well as during vacations in various teacher training centres all over the country. It may be safely assumed that by 1973 all high school biology teachers in Israel are familiar, at least to some degree, with the philosophy and rationale of the BSCS as well as with some of the materials. However, while some teachers have been teaching the BSCS curriculum entirely, others have still been following a non-BSCS curriculum, while still others have been using both BSCS and non BSCS materials.

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The purpose of the present study is to determine the attitudes of high school biology teachers to the BSCS program in Israel. It is assumed that teachers' attitudes concerning curricular materials must be considered if successful implementation of these materials is to be achieved.

Method

The Attitude Inventory designed to determine reactions of biology teachers to the BSCS biology (5) was translated into Hebrew and used in the present study*. This instrument consists of 46 statements half of which judged to be in agreement with the BSCS rationale and philosophy while the other half judged to be in disagreement with them. A complete agreement with the key will result in a score of 46, a complete disagreement with the key will result in a score of zero.

The Attitude Inventory was validated in the U.S. by Blankenship using peer rating, instructors' rating and a follow-up questionnaire (5), as well as a follow-up study which showed that 69% of the teachers who had favorable attitudes as compared with only 31% of those who had unfavorable attitudes (as measured by the Attitude Inventory) were actually teaching a BSCS course (6). It was also validated by Kochendorpher who found a correlation of 0.73 between Attitude Inventory scores and the actual activities in the classroom as measured by the Biology Classroom Activity Checklist scores (7).

The Attitude Inventory was mailed to 20 high schools, all over the country representing all types of high schools in Israel with a request that the biology teachers will check their responses (i.e. agree or disagree with each of the 46 statements) and mail it back. They were also asked to identify the type of school where they teach and the curriculum they have followed).

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*The author acknowledges Addison E. Lee, Director of the Science Education Centre, The University of Texas at Austin for his kind permission to use the Inventory.

Findings

111 complete inventories were received. Table 1 presents some information about the respondents which shows that as a sample they adequately represent the population of high school biology teachers in Israel.

Table 1. Distribution of respondents according to the type of school, sex and curriculum materials.

Group		Number of teachers	%
type of school	agricultural	21	19
	rural (Kibbutz)	27	24
	comprehensive	25	23
	city academic	38	24
sex	male	59	53
	female	52	47
Curriculum	traditional	22	20
	traditional & BSCS	18	16
	BSCS	71	64
	BSCS experienced	24	22

The curriculum used and attitudes

Table 2 presents the mean scores of the whole sample as well as the mean scores of teachers using different programs. The reliability as determined by the KR-20 formula for the whole sample was 0.81

Table 2: Mean scores on the Attitude Inventory of teachers using different programs

Program	N	Raw mean score	S.D.	Percentage mean score
whole sample	111	30.70	6.19	67
traditional	22	27.32	5.92	59
traditional & BSCS	18	29.56	7.92	64
BSCS	71	33.03	5.41	71
BSCS experienced *	24	35.42	4.32	77

*These 24 teachers are part of the 71 BSCS teachers. They are represented also as a separate group because they have had a special experience in teaching biology majors in grades 11 and 12 who took the BSCS matriculation examination, a special type of comprehensive examination which reflects the "science as enquiry" philosophy of the BSCS (8, 9).

The difference between the mean scores of the traditional group (N=22) and the BSCS group (N=71) was stistically significant at the 0.01 level (t=3.83).

Table 3 presents the statements to which the traditional group responses differed significantly from the BSCS group responses. These differences and their implications will be referred to in the discussion.

Table 3: Items which reveal statistically significant differences between traditional and BSCS teachers

Item (numbers as they appear in the Inventory)	Percentage whole sample N=111	mean score[a] traditional N=22	BSCS N=71	X^2 **
5.*Students gain more scientific knowledge by participation in BSCs-type laboratory work	53	32	63	6.69
6. It would be difficult if not impossible, to teach the BSCS biology course in its present form	62	32	73	18.30
11.A practical biology course that has immediately usable information for the student is needed in the high school	68	59	73	8.76
12*BSCS biology adequately provides for differences in student ability	31	9	38	9.35
19.Accurate evaluation of the student's achievement in a laboratory oriented course such as the BSCS course would be impossible	71	46	80	15.99
26.The BSCS biology program seems designed exclusively for the above average student	39	23	45	8.50
40.Biology should be taught as a body of factual information	42	27	48	8.31
41*The BSCS biology program reflects careful planning of a practicable course	42	23	44	8.05
44.The amount of time suggested for laboratory investigation in the BSCS biology program is exessive	73	32	85	27.68

a) percent of teachers in agreement with the key

* items judged to be in agreement with BSCS rationale and philosophy.

** All X^2 values are significant at the 0.01 level.

Types of schools

High school biology in Israel is taught in four types of schools. Table 4 presents the responses of teachers in different types of schools.

Table 4: Mean scores in the Attitude Inventory of teachers in different types of schools

School type	N	Mean raw score	S.D.	Percentage mean score
agricultural	21	30.60	545	67
rural (kibbutz)	27	33.56	4.89	73
comprehensive	25	31.26	5.86	68
city academic	38	30.10	7.49	65

Table 4 shows that rural teachers had the most positive attitudes. The only statistically significant difference was between rural and city academic teachers ($t=1.95$, > 0.05). The rural teachers were statistically significant different than the other groups in that they almost unanimously disagreed with the statements which criticizes the central role of the laboratory in the BSCS course (items 7, 31, 44) as well as to the statements which advocated a practical biology course with a major emphasis on structure and function of organs and tissues (items 11 and 13). Teachers in academic city schools demonstrated statistically significant different responses as compared with other groups revealing the following reservations: 58% believed that it would be difficult if not impossible to teach the BSCS biology course in its

present form (item 6). The same percentage opposed the suggestion to use six weeks of concentrated laboratory work in one area of biology (item 21) as well as to the statement emphasizing the importance of the student engagining in scientific enquiry (item 27).

Teachers in agricultural schools have found it especially difficult to carry on accurate evaluation (item 19, mean score 57%) as well as to agree that a major emphasis should be placed on the molecular, cellular and community aspects of biology (item 23, 29%). 81% of these teachers believed that the BSCS biology program was designed exclusively for the above average student (item 26).

The implications of these findings will be discussed later.

Male and female teachers

Statistically significant differences between male and female teachers were found in 5 of the 46 items (Table 5). The implicatio of these differences are dealt with in the discussion.

Table 5: Mean percentage scores in items in which statisti ly significant differences were found between mal and female teachers.

Item (numbers as they appear in the Inventory)	Percentage mean score[a] Females	Males	X
[b]1. Laboratory work should be more closely integrated with the text material	83	97	5
7. It is not necessary that students actually perform laboratory work in order to understand the principles of scientific investigation	37	59	8
[b] 27. It is only by engaging in scientific enquiry that the student becomes able to discern the difference between experimentation and complex instrumentation	62	80	12
28. Actually the so-called conventional high school biology and the BSCS biology course are quite similar	77	93	10
36. Laboratory exercises should stress the names of structures and processes	48	61	11

a) percent of teachers in agreement with the key.
b items judged to be in agreement with the BSCS rationale and philosophy
* significant at 0.05 level
** significant at 0.01 level.

Discussion

Table 3 indicates several issues which account for unfavorable attitudes on the part of the traditional teachers. Most of these teachers believe that it is difficult, if not impossible to teach the BSCS course in its present form. Plausible reasons for these difficulties appear to be: too much time devoted to laboratory investigations, relatively low emphasis on immediate usuable information, the reluctance of the BSCS to view and present biology as an organized body of knowledge and, most significantly their belief that accurate evaluation of students' achievement in a BSCS type course is virtually impossible.

It is interesting to note that even BSCS teachers have some reservations. For instance, most BSCS teachers do not believe that the BSCS adequately provides for differences in students' ability. (items 12 and 26). Similarly, most of the BSCS teachers do not believe that the BSCS biology reflects careful planning of a practicable course, perhaps because it is not presented as an organized body of knowledge (items 41 and 40). Yet, even with these items, BSCS compared with non-BSCS teachers have significantly more favorable attitudes. Planning instruction and adequately providing for differences in ability require special attention and may need more experience than other issues to which most of the BSCS teachers have highly favorable reactions. Thus, it appears that experience in teaching the BSCS biology is very important. Teachers appear to need time for gradual adaptation to teaching a new curriculum. As they gain more experience they find it less difficult and more

easily manageable. The fact that experienced BSCS teachers reveal the most positive attitudes (Table 2) lend support to this conclusion. At the same time, some of the reservations of the BSCS teachers, especially in providing for ability differences, indicate real weaknesses of the BSCS program. Recently more attention is given to the effects of the general set-up and the school atmosphere on curricular innovation (10). Our findings indicate that the BSCS program has been most highly regarded by the rural (kibbutz) teachers and least highly regarded by city academic school teachers. The rural teachers find the laboratory-enquiry oriented course to be most approrpiate while the teachers in city academic schools find the teaching of inquiry oriented course to be rather difficult. This relatively more favorable attidue of the rural teachers is in good agreement with a long tradition of more individualized laboratory oriented teaching in rural-cooperative settlements (11).The reservations made by teachers in agricultural schools are of special interest. These schools have a relatively high percentage of lower ability students of low socio-economic status. Follow-up evaluation studies have shown that the BSCS Yellow version is indeed too difficult for many of the students in these schools. Similarly it was found that the achievement of these students in the two experimental BSCS trials conducted in 1967 to 1969 were significantly lower than that of students in other types of schools even when IQ was held constant by analysis of covariance (12). The fact that 71% of the teachers in agricultural schools are reluctant to accept the BSCS emphasis on the molecular, cellular and community levels, perhaps because of the higher level of abstract thinking and formal logic involved, may indicate where the difficulty of the BSCS course, regarding the type of students in agricultural schools, lies. In passing it may be noted that recently Patterns and Processes (2) has been recommended and used by many agricultural schools. As to the comparison of male and female teachers it appears that male teachers are more willing to teach biology by enquiry and to build their courses based on students

work in laboratory. Perhaps this is the reason why male more than female teachers, conceive the BSCS course to be different from the traditional biology course.

Summary and conclusions

An Attitude Inventory towards the BSCS biology which had been developed and validated in the U.S. was translated into Hebrew and used to ascertain the attitudes of high school biology teachers in Israel in the year 1973 toward the local adaptation of the BSCS program, The Attitude Inventory succesfully differentiated between teachers of favorable and teachers of unfavorable attitudes toward the rationale and philosophy of the BSCS program. It has been found that teachers who teach the BSCS course have significantly more favorable attitudes than those who use traditional materials. It has also been found that, on the average, the more experienced the teachers are in teaching the BSCS, the more favorable their attitudes are toward the course. This is interpreted to mean that teachers who adopt a new curriculum need an adaptation period durin which they learn to handle the materials and to overcome emerging difficulties, thereby acquiring more faith in and more comfort wit the new program. The study reveals some weakness in the BSCS progr especially for certain types of students in certain types of school In addition it shows that some teachers teach the BSCS course, but still hold unfavorable attitudes toward its rationale and philosoph Special efforts are needed to change these unfavorable attitudes in order to ascertain the type of instruction advocated by the BSCS project. Alternatively, it is suggested that teachers who still maintain unfavorable attitudes, as measured by the Attitude Inventory, will not teach a BSCS-type course.

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Summary

The purpose of the present study is to determine the attitudes of high school biology teachers to the BSCS program in Israel. It is assumed that teachers' attitudes concerning curricular materials must be considered if successful implementation of these materials is to be achieved.

An Attitude Inventory toward the BSCS biology, developed by Blankenship in the U.S. and validated there by him and by others was translated into Hebrew and used in the present study. This instrument consists of 46 statements half of which judged to be in agreement with the BSCS rationale and philosophy while the other half judged to be in disagreement with them. The Inventory was mailed to 200 high schools all over the country, representing all types of high schools in Israel with a request that the biology teachers will respond. 111 complete inventories were returned by mail adequately representing the three alternative curricula used in Israel, namely BSCS (64%) traditional (20%) and a mixed program using some traditional and some BSCS materials (16%). They also consist of a representative sample of teachers regarding sex (53% males) as well as the different types of schools in the country (agricultural 19%, rural - kibbutz 24%, comprehensive 23%, city academic 24%).

The mean scores of the different groups on the Inventory were compared by t-tests. The percentage scores on the individual items were compared by Chi-square.

The major findings are as follows:

a. The Blankenship Attitude Inventory successfully differentiated between teachers of favorable and those of unfavorable attitudes toward the BSCS program in Israel.

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b. Teachers who teach the BSCS course have significantly more favorable attitudes toward the philosophy and rationale of the BSCS than those who use traditional materials. Moreover, the more experienced the teachers are in teaching the BSCS, the more favorable their attitudes are toward the program.

c. Although the adoption of the BSCS course in Israel is on a voluntary basis, some teachers who teach the BSCS course hold unfavorable attitudes toward certain components of the BSCS philosophy.

d. There are some significant interactions between the school environment and the attitudes of teachers toward the BSCS. For example, the BSCS program is most highly regarded by teachers in rural-kibbutz school and least highly regarded by teachers in city academic schools, the latter find it very difficult to teach an enquiry oriented course under the constraints of their school environment.

e. Male teachers, on the average, are more willing than female teachers to teach biology by inquiry and to build their courses based on the students work in the laboratory.

h. The study reveals that most teachers find certain weaknesses in the BSCS program. For example, even the BSCS teachers do <u>not</u> believe that the BSCS Yellow Version adequately provides for differences in students' ability.

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The following implications are warranted by the findings: Special care should be taken in order to ascertain that a new curriculum to be adopted can be taught under the specific local conditions. Teachers who adopt a new curriculum need an adaptat period during which they learn to handle the materials and to overcom emerging difficulties, thereby acquiring more faith in more comfort with the new program. Special efforts are needed to explain the rationale and philosophy of the program to the teachers. It is highly improbable that teachers who teach the course and still hold unfavorable attitudes toward its philosop will use the type of instruction advocated by the BSCS. Specia efforts are needed to change such unfavorable attitudes, or alternatively, it is suggested that teachers who still maintain unfavorable attitudes, as measured by the Attitude Inventory, will not teach a BSCS-type course.